H2Ops

UNCULTURED: THE DISINFECTION ISSUE MAY 2018

WATER TREATMENT AND DISINFECTION: FROM FERMENTATION TO FILTRATION

BY ANTHONY JAMES, PUBLIC INFORMATION OFFICER

As summer approaches, enjoying a cold brew on a hot, sunny day may sound enjoyable. But, for thousands of years, people turned water into alcohol because it was a necessity for human health.

Humans have always formed civilizations around a source of clean drinking water. This put people near plentiful water, but not necessarily safe water. Ancient civilizations, from the Greeks to the Babylonians, produced alcohol as a way to make the water safe to drink. Fermented drinks such as mead, wine, and beer were precious commodities that people drank throughout the day.

Early water treatment methods focused on removing visible contaminants. Methods included filtering through charcoal, exposing to sunlight, boiling, and straining. Cloudiness (turbidity) was the main reason for these filtration methods, as the source water often had taste or appearance issues. By the early 1800s, slow sand filtration—a technique still used today—was introduced in many parts of Europe to remove visible particles from water.

It wasn't until the mid-1850s when scientists began to understand the contaminants invisible to the naked eye. Diseases such as cholera and typhoid fever killed many people each year. At the time, raw sewage was often dumped in or near drinking water sources. People believed that the natural environment would dilute or filter the sewage. They knew little about the diseases raw sewage carries.

In 1855, epidemiologist Dr. John Snow traced a cholera outbreak in London to a well contaminated by sewage. Near the end of the century, Louis Pasteur demonstrated the "germ theory" of disease, explaining how microbes transmit disease through water.

In the early 1900s, Jersey City, NJ became the first U.S. city to chlorinate its water and over the next few decades, chlorination became the standard for drinking water treatment. Cases of cholera and typhoid fever dropped dramatically in cities with installed water treatment. The Centers for Disease Control and Prevention named drinking water treatment as one of the top 10 public health achievements in the 20th century.

Federal and state drinking water standards evolved throughout the 20th century. By the 1950s, it was becoming clear that the primary contaminants in drinking water sources came from industry and agriculture. This led to the Safe Drinking Water Act of 1974. At the same time, improved treatment methods were introduced, including reverse osmosis and ozonation.

The next time you enjoy a glass of your favorite alcoholic beverage, make a toast and think about how it led to the safe drinking water we have today.

Mesopotamian pay stub for a worker, noting how much beer he was paid for his labor. Workers in the ancient world were often paid in beer, as much as for or five liters per day. Photograph by Jim Kuhn CC 2.0 2008

DISINFECTANT RESIDUAL MONITORING: ACCURACY MATTERS

BY NATHAN IKEHARA, ENGINEERING AND TECHNICAL SERVICES

Do you disinfect your water? How do you know? You could assume that pouring bleach into a container connected to a working pump, connected to your water system, means that a certain amount of disinfectant is going into your water. But how do you know that disinfectant is sufficient to actually disinfect your water?

If you disinfect your source, think about Thanksgiving dinner as an illustration. Turning the oven on does not guarantee a cooked bird in time for dinner. There has to be enough heat for enough time or you are going to end up ordering a pizza. Source disinfection works in a similar way. It requires the appropriate concentration of disinfectant for the appropriate amount of time. And, just like the weight of the turkey changes how long you have to cook, the pH and temperature of the water change the amount of time or concentration required to effectively disinfect.

If you disinfect your distribution system, think about a potluck. The egg salad was probably safe when your neighbor put it out, but unless you know how long it's been there and what temperature it's been sitting at, you probably want to leave it off your plate. To prevent unwanted growth, you have to maintain an environment that prevents it. Accurate disinfectant residual measurements let you know if you are maintaining that kind of environment.

To ensure accuracy, check your equipment and your processes. Different devices have different levels of accuracy. The owner's manual that came with your device should tell how accurate it is. While you are reading that manual, we recommend that you pull out the fine print about equipment care, sample steps, troubleshooting, and so on. Use that information to make your own simple, consistent testing protocol. A consistent approach will make testing easier and variations in disinfection residual more obvious.

Now you are ready to test! But where to sample? Remember the turkey? Sampling the temperature of a wing won't tell you if the breast is safe. We call the right sample location your compliance point. If you disinfect your source, the compliance point must be at or before the first customer. Distribution compliance points are at representative locations throughout the distribution system. Pay close attention to your sample site. Simple oversights like not running the water long enough can lead to significant changes in results. So, take time to write down what to do at a sample site and help to eliminate bad data.

If you have questions, or you'd like additional information, please contact us.

COMMON DISINFECTION ISSUES FOUND IN SANITARY SURVEYS

BY BRIAN BOYE, NWRO SANITARY SURVEY PROGRAM MANAGER

Sanitary surveys can uncover any number of disinfection issues with your system. Even if you're an experienced operator, sanitary surveys routinely find disinfection issues, including:

Openings in chlorine solution tanks. Besides allowing contaminants to get into your chlorine tanks, these leaks can cause corrosion and damage your treatment plant's equipment. Recommendations may include fixing leaks, sealing solution tanks, or moving chlorinators to separate buildings or enclosures.

Chlorine solution tanks in unapproved containers. Solution tanks must be in containers meeting NSF 61 standards.

Cross connections caused by unprotected water supply lines submerged in chlorine solution tanks. This is a significant deficiency. To fix this issue, you must install an air gap or reduced-pressure backflow assembly on the water supply line.

Missing or misplaced sample taps. For example, no source water sample taps located upstream of the chlorine injection site, or no post-treatment sample tap. Both are significant findings.

Monthly chlorination report errors include failing to send them to **DOH,** not maintaining a minimum free chlorine residual every day, not testing the required number of days or not knowing what level of performance your system must provide or why.

Installing unapproved treatment and removing or inactivating treatment may be a significant finding.

Inadequate operation and maintenance schedule for disinfection equipment and controls. Do you have spare parts on hand? A backup chemical feed pump? Annual replacement part kits?

Improper chlorine testing. During a sanitary survey, the surveyor will ask to make a measurement with the operator doing the same. This has uncovered many findings over the years and serves as an opportunity to correct any practices.

Testing equipment in need of replacement. Stained or scratched testing vials and expired reagents can heavily affect your residual readings. Take care to thoroughly rinse and clean vials after each use; leaving water with reagents inside the vial can stain the vial over time. You also should replace vials on a regular basis, especially when they begin to show wear.

Improper testing equipment. The drinking water rule no longer allows systems required to disinfect the source and meet a CT of 6 (chlorine residual x contact time =6) to use a color wheel to take residual measurements. They must use a digital colorimeter. We recommend that everyone upgrade to a digital colorimeter test kit and quit using color wheels.

Regular shock, batch, or hand chlorination may be a problem if it interferes with coliform sampling and is not a substitute for effective disinfection treatment. Be upfront with the surveyor and explain what you're doing and why. The surveyor may be able to suggest improvements.

CASE STUDY: VERA WATER AND POWER INSTALLS CONTINUOUS CHLORINATION

BY JEFF JOHNSON, REGIONAL ENGINEER

After operating without treatment for more than a century, one Spokane area water system found itself with four total coliform violations within a year, which required adding treatment.

Established in 1908, Vera Water and Power serves about 10,500 connections. Their service area encompasses about 16 square miles, about a third of which is in the eastern portion of the City of Spokane Valley, with the other two-thirds in unincorporated Spokane County south of the City. Vera's facilities include nine wells, five reservoirs, and about 145 miles of distribution system mains. Vera also has emergency interties with neighboring water districts.

For most of its history, Vera did not treat the water they produced. In the last couple of decades, Vera had occasional total coliform positive samples. These violations were generally in the fall, and were thought to be due to improper practices during sprinkler blow-outs.

Then, in late 2012 and early 2013, Vera had four total coliform water quality violations within eight months. In April 2013, the Office of Drinking Water (ODW) required Vera to provide continuous disinfection for their distribution system. Vera and ODW entered into a compliance agreement that included milestones and deadlines for completing the project.

Vera's consulting engineer prepared a project report in June 2013 evaluating the possible alternative approaches to providing continuous disinfection at Vera's wells. Construction documents for the selected alternative were also included in the report. The alternatives included in the evaluation were Accu-Tab calcium hypochlorite tablet system, sodium hypochlorite (12.5%) injection system, and chlorine gas.

Vera selected the calcium hypochlorite tablet system based on a relatively low safety risk and straightforward operational procedure. Another deciding factor was that two nearby water systems use the calcium hypochlorite tablet system and reported positive results. A separate chlorination building was planned for each well site, to keep chlorine vapors away from the well, electronic control panels, and other equipment susceptible to corrosion. A few well sites had multiple wells, so only seven chlorination buildings were needed.

The final design and plumbing details were completed in house with the direction of the Vera District Engineer and the Vera Water Foreman. Construction of the first chlorination building and tablet chlorinator system was completed in December 2013. Six more sites were constructed at Vera well sites over the next two and a half years. The Vera water crew completed installation of the chlorination systems. Each installation was quicker and more efficient than the one before because the Vera crew kept track of lessons learned and updated their procedures each time.

2017 CHANGES TO GROUNDWATER PRIMARY DISINFECTION RULES

Monitoring frequency

Groundwater sources required to provide primary disinfection treatment must conduct field measurement of chlorine residual at the point of entry to the distribution system. The frequency changed from sampling every workday (Monday-Friday, except holidays) to sampling any five days per week.

Maintaining detectable residual disinfectant concentration

A water system required to provide only primary disinfection is no longer required to measure, report, and maintain a detectable residual disinfectant concentration in the distribution system. However, we recommend all chlorinated systems measure and record free chlorine residual from a representative location in their distribution system at least 5 days per week. This is good operational practice and can help alert you to problems or deficiencies in your distribution system. The distribution residual requirement applies only to systems required to provide secondary disinfection.

Approved Field Test Method

Given the importance of accurate chlorine residual measurement for primary disinfection, water systems must now use an EPA-approved method, such as a digital colorimeter, to measure free chlorine residual. Water systems can no longer use color wheels or test strips for this purpose.

Trigger for CT6 treatment

The revised rule includes an expanded set of circumstances for triggering CT6 primary disinfection treatment, including wells constructed in vulnerable hydrogeologic settings, poorly constructed or shallow wells, and seawater desalination treatment.

Established treatment, reporting, and monitoring violations

For the first time, the rule defines a monitoring, reporting, and treatment violation for systems required to provide primary disinfection. DOH is devoting resources to ensure water systems sample, report, and provide the level of treatment expected when primary disinfection is required.

GROUNDWATER CONTACT TIME

BY SCOTT TORPIE, ENGINEERING AND TECHNICAL SERVICES

If your groundwater source is vulnerable to microbiological contamination or water quality data confirms E. coli, you need to provide continuous primary disinfection. Primary disinfection kills or inactivates 99.99 percent of viruses and bacteria.

Using free chlorine, primary disinfection must provide a CT value equal to or greater than 6. Calculate the CT value by multiplying the free chlorine residual concentration (C) in mg/l by the chlorine contact time (T) in minutes. CT6 applies where the treated water temperature is greater than or equal to 10°C and pH is 6 to 9. If the temperature is less than 10°C, the minimum required CT is greater than 6.

Contact time (T) is calculated at peak hourly flow between the chlorine injection point and the residual chlorine monitoring location. The residual disinfectant monitoring location must be at or before the first customer. Assessing contact time in minutes can be challenging because contact time depends on a number of factors, including flow rate and baffling efficiency.

Because you should use the peak flow rate for each day to calculate T, it's important to accurately measure or anticipate the peak flow rate. Baffling efficiency is the portion of the storage tank or pipe volume you can apply to determine chlorine contact time. Tanks without baffles have a low baffling efficiency because of "short-circuiting." The baffling efficiency multiplied by the operational tank level equals the volume you can use to calculate T.

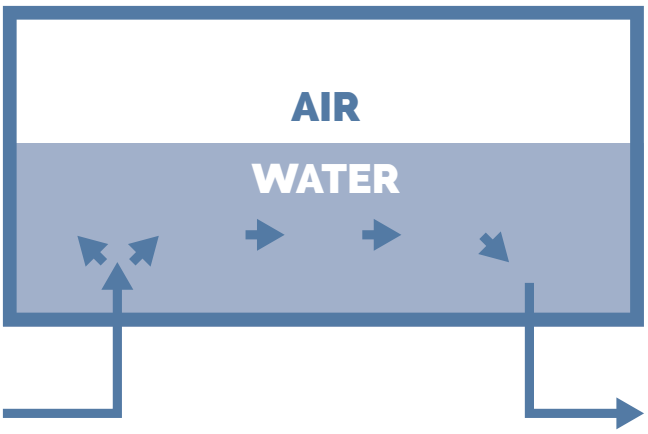
For example, a 1,000-gallon tank with the water level during peak flow at 60 percent of the total volume and a baffling efficiency of 10 percent has a volume available for contact time of 1,000 gallons x 0.6 x 0.1 = 60 gallons. If the peak flow rate through the tank is 30 gpm, then the contact time through the tank is only 2 minutes.

Secondary disinfection involves adding a chlorine compound at a source or pump station to establish a residual disinfectant to establish or maintain microbiological control throughout the distribution system. If the treatment is limited to secondary disinfection, CT6 primary disinfection operational and monitoring requirements don't apply.

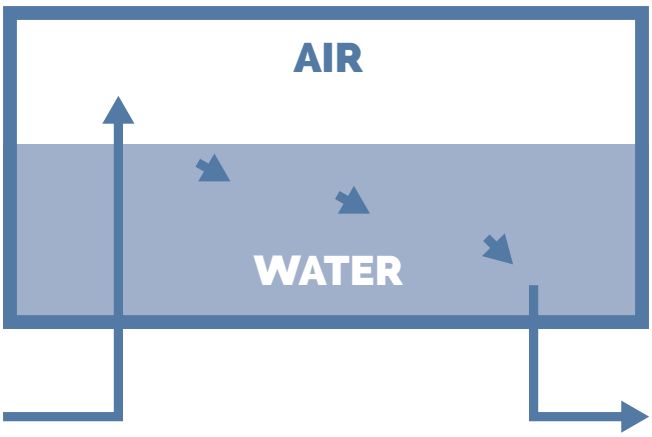
In summary, to calculate CT you must know the:

- T (contact time) for each water system component between the chlorine injection point and where free chlorine is measured before the first customer.
- Volume and baffling efficiency of each component
- Peak flow through each component.
- Free chlorine residual measured downstream of all the components and upstream of the first customer.

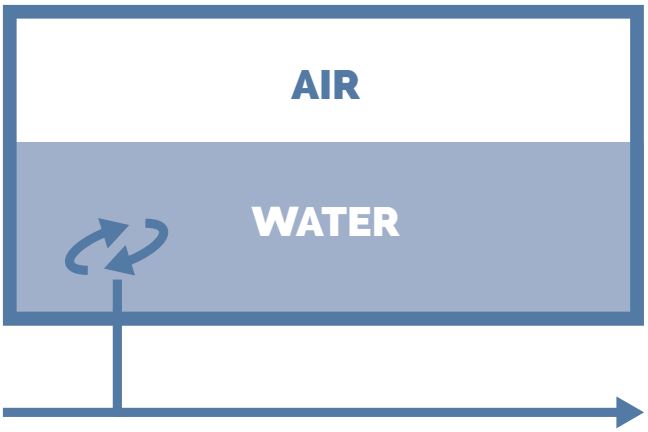
For more information and assistance calculating contact time, see Chlorine Contact Time for Small Water Systems (331-343) at **doh.wa.gov/odwpubs/.**



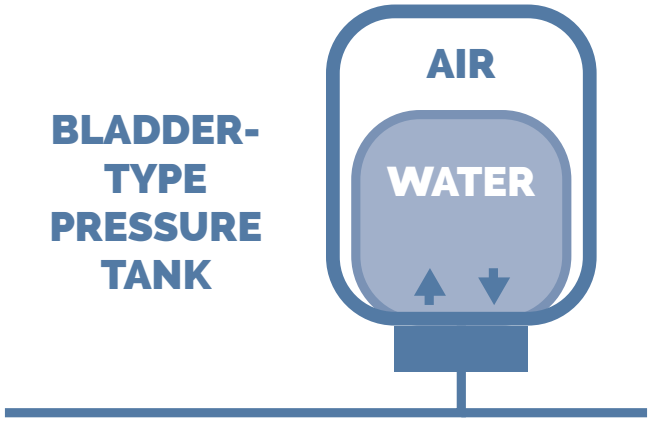
Poor contact time efficiency. Baffling efficiency = 5-10%.



Poor contact time efficiency. Baffling efficiency = 10%



No circulation. Baffling efficiency = 0%.



No circulation. Baffling efficiency = 0%.

COLIFORM MONITORING PLANS

BY CAROL STUCKEY, COLIFORM PROGRAM MANAGER

In the extensive files for your water system, your Coliform Monitoring Plan (CMP) should rise to the top as the definitive source of information for all coliform-related topics.

The benefits of an accurate and up-to-date CMP are many, including:

- Quick reference for what to do if you ever have an unsatisfactory coliform sample.
- Eliminates the need to scramble "in the moment" to determine where to collect repeat samples. You must collect repeat samples within 24 hours of learning about an unsatisfactory routine sample.
- Minimizes stress (hopefully!) if you ever have E. coli present in your system.

All Group A water systems are required to have a written CMP. If you don't know when your CMP was last updated, check that out right now! Ideally, your plan was updated to reflect the Revised Total Coliform Rule, which went into effect April 1, 2016.

Your plan should be a living document, updated as needed to reflect changes in your water system facilities or operations. For example, changes in your distribution system or adding or deleting a groundwater source would require an update to your plan.

You should review your plan annually. The annual review should include:

- Revising the number of routine samples needed per month if the population you serve has changed (see Table 2 in WAC 246-290.)
- Determining whether additional routine sample sites are needed. At least one routine sample site should be located in every pressure zone. We expect at least one routine site in every zone that serves 100 or more connections.
- Ensuring all of your designated routine coliform sample sites remain representative of your distribution system.
- Ensuring that all of your chosen repeat sites are still accessible and representative.
- Checking that the written sample collection procedure (standard operating procedures or SOP) describes your system's current method for sample collection. An SOP should be in place for each type of sample site designated for routine or repeat sample collection.

You must have your CMP available during a sanitary survey. You also must submit your plan for Department of Health review and approval when requested to do so, and as part of your Water System Plan. It is very helpful for us to have a copy of your current CMP on file so that we can provide you with the most help possible if you ever have a coliform contamination problem.

Detailed guidance for the contents of your CMP are in Preparing a Coliform Monitoring Plan (331-036) available at **doh.wa.gov/odwpubs/.**

All Group A water systems are required to have a written CMP. If you don't know when your CMP was last updated, check that out right now!

Key components of a CMP

Basic system information: List of system facilities and features such as number of sources, types of treatment, inventory of storage tanks, number of pressure zones, population by pressure zone, and so on.

Lab contacts: Include contact information for your primary lab and a back-up lab.

Sample sites: List locations for each routine sample site and associated repeat sample sites. Include Groundwater Rule-triggered source sample sites if your system has permanent or seasonal groundwater sources.

System map: Show all routine sample sites, sources, treatment plants, storage tanks, and pressure zones.

Sample collection: Detailed and dated sample collection SOP. Routine sample rotation schedule, if applicable.

Assessment: Contact information for people who can do a Level 1 assessment and people who are qualified to do a Level 2 assessment.

E. coli Response Plan: The necessary steps to take if you ever have E. coli present in your distribution system. If you have permanent or seasonal groundwater sources, include an E. coli Response Plan for groundwater sources.

Justification for Reduced Triggered Source Monitoring under the Groundwater Rule, if you want to request approval for this.

Wholesaling groundwater: If applicable, include contact information for systems that you sell groundwater to, systems from which you purchase groundwater, or both.

If you have any questions about coliform monitoring or updating your CMP, contact your regional office coliform program manager: Charese Cryderman, Southwest Region 360-236-3030; Joseph Perkins, Eastern Region 509-329-2100; and Ingrid Salmon or Carol Stuckey Northwest Region 253-395-6750.

NEW! PAY ONLINE FOR YOUR WATER SYSTEM OPERATING PERMIT

We now accept electronic payment for water system operating permit and operator certification fees via our online portal. Payment options now include checks, ACH payments made through banks, or most credit cards. A convenience fee may apply depending on your payment choice.

In either case, please make sure you include your public water system ID number in the documentation so we can credit your payment to your water system.

For instruction on how to use this electronic service, visit **doh.wa.gov/payopnow.**

CERTIFICATION FOR DRINKING WATER CHEMICALS: YOUR QUESTIONS ANSWERED

BY NANCY FEAGIN, SURFACE WATER PROGRAM ENGINEER

Do you have questions about the safety of your water treatment chemicals? Do you need to know more about your roles and responsibilities ensuring that safety? If so, you are not alone! We get many questions from utility staff who want to know what to look for on packages of chemicals they receive. The answers can be complicated. They can get even more complicated when chemicals are repackaged or modified after they leave the original production facility.

Below, answers to common questions from utility staff provide background on the product listing and certification system.

What are the specific requirements for public water systems in Washington?

"Any treatment chemicals, with the exception of commercially retailed hypochlorite compounds such as unscented Clorox, added to water intended for potable use must comply with ANSI/NSF Standard 60." (WAC 246-290-220(3))

What is ANSI/NSF Standard 60?

ANSI is the American National Standards Institute, a non-profit organization that oversees the development of voluntary consensus standards for products, services, processes, systems, and personnel in the United States. NSF International (formerly the National Sanitation Foundation) is a product testing, inspection and certification organization

ANSI/NSF 60 is the universal standard for certification of drinking water chemicals. Developed by a team of scientists, industry experts and key industry stakeholders, ANSI/NSF 60 sets health effects criteria for many water treatment chemicals, including corrosion and scale inhibitors, coagulants and flocculants, disinfection and oxidation chemicals, pH adjustment, softening, precipitation and sequestering chemicals, and all other specialty chemicals used in drinking water treatment.

What are listing organizations?

Listing organizations are not just testing labs. They have specific duties under the standard, including extensive product testing, material analyses and unannounced plant inspections. According to the NSF website, "Certification is not a one-time event, but involves regular on-site inspections of manufacturing facilities and regular re-testing of products to ensure that they continue to meet the same high standards." Listing organizations must be accredited by ANSI.

I'm familiar with NSF. Are there other accredited listing organizations?

In addition to NSF, ANSI accredited the Water Quality Association (WQA), Underwriters Lab (UL), and the Canadian Standards Association (CSA). Each of these accredited organizations is considered equivalent to any other.

If a chemical is repackaged or diluted after it leaves the original production facility, is it still certified?

ANSI/NSF 60 certifications are facility site-specific. The integrity of a product can be compromised if it is modified after it leaves the manufacturing facility. Transferring the chemical to a different container or repackaging it could add contaminants from equipment or containers that contact the chemical. Even tap water used for dilution might introduce contaminants.

For this reason, blended, diluted, dissolved, relabeled, and transferred or repackaged products are not considered certified unless the final processing facility is also certified. Facilities that process already-certified products must have at least one listed product from their own facility. This ensures that the listing agency inspected and audited the final processing facility against strict quality control standards.

This sounds complicated. How can I ensure that the products I receive are properly certified?

All packages (including drums, totes, bags or Super Sacks) of ANSI/NSF 60 certified products must be labelled with, or accompanied by shipment-specific documentation containing, the following information:

- Certified company name
- Facility location
- Product name
- Lot number or production identifier
- Net weight or volume designation

The NSF certification mark means the product complies with all standard requirements. NSF conducts periodic unannounced inspections and product testing to verify that the product continues to comply with the standard.

In addition to the five items listed above, the certifying agency's mark and the Maximum Use Level (MUL) of the product (shown in the Standard 60 listings) must appear on either the product label or one of the documents accompanying the shipment. For package shipments like totes or drums, the NSF Mark and MUL may be on an enclosed document or on the product container itself.

What about bulk shipments?

For bulk shipments, the information listed above must appear on at least one of the documents with each shipment. This could be a Materials Safety Data Sheet (MSDS), Certificate of Analysis, Technical Data Sheet or other document.

What else should I check?

In addition to the labeling and documentation, utility staff should periodically check to ensure that the specific company and product appear in the ANSI/NSF Standard 60 listings.

What kinds of records do I need to keep?

You must obtain shipment documents with the information listed above for each delivery. You must keep these documents for at least three years (WAC 246-290-480(1)(g)), and be able to produce them upon request.

Contact your regional office if you have questions or need more information.

NEED HELP? DISINFECTION PUBLICATIONS

Please call us with any questions you have about disinfection (Eastern Region 509-329-2100, Northwest Region 253-395-6750, Southwest Region 360-236-3030).

You can also check out the publications we created to help operators with frequently asked questions. Just type a key word or the publication number into the search bar at **doh.wa.gov/odwpubs/** and hit "enter." Here are some examples:

Emergency Disinfection of Small Systems (331-242). 4 pages. Explains when you need emergency disinfection and how to do it. Tables show how much chlorine bleach to use to disinfect a well, reservoir, and distribution system.

Disinfection Byproducts (331-251). 2 pages. FAQ explains how disinfection byproducts form, types of systems that use chlorination, human health effects, and regulations.

Alternate Disinfectants (331-252). 2 pages. FAQ on the advantages and disadvantages of various disinfectants.

Chlorination of Drinking Water (331-253). 2 pages. Discusses why systems continuously chlorinate drinking water, the history of chlorination, and the effects of chlorination on human health.

Regulating disinfectants and disinfection byproducts (331-254). 2 pages. Describes the drinking water standards and monitoring requirements for disinfection by-products.

Chlorine contact time for small water systems (331-343). 2 pages. Explains chlorine contact time, estimated baffling efficiencies for various storage and pressure tanks, and sample calculations.

How to Handle Chlorine Gas Safely (331-364). 6 pages. Explains how to detect chlorine leaks, safety tips and protective equipment, chlorine first aid, and how to change chlorine cylinders.

Chlorination Controls (331-398). 4 pages. Explains how fixed- and variable-rate chlorine injection systems provide consistent, minimum free chlorine residual while a water system operates.

Water Main Break Response Protocol for Chlorinated Water Systems (331-583). 3 pages. Explains what to do if you have a water main break.

HIGH 5, PESHASTIN!

SYSTEM ADDS TREATMENT AFTER POSITIVE E. COLI SAMPLE

A positive E. coil sample is something no operator wants to hear. In the small town of Peshastin, it happened in October 2017.

Operator Jason Williams said a routine source sample for the Peshastin Water District came back positive. So did the repeat samples. From there, the district sprang into action, shutting off the contaminated well and relying on its two other wells. The boil water advisory public notice was delivered to its 283 customers.

The system quickly hired an engineer, designed a CT6 disinfection system, and sought funding for the equipment. The new chlorination system went into operation in March 2018.

There were any number of potential causes for the positive sample. Theories include old septic tanks, a packing warehouse, or a stormwater outfall. "Be aware of your surroundings," Williams said. "We were trying to find something wrong and we couldn't find it."

District management also learned a few lessons from the situation. The water district's board established an emergency fund to help cover the costs of future incidents. Williams said he is also looking for funding to replace the contaminated well.

Despite the training and preparation, "you never think you'll have to deal with this," Williams said.

Peshastin from the bank of the Wenatchee River. Photo by Nwcamera1 CC BY-SA 3.0.

Washington State Department of Health

PO Box 47822
Olympia, WA 98504-7822

H_2Ops is a publication of the Washington State Department of Health Office of Drinking Water, 331-500. If you want to receive this publication in an alternative format, call 800-525-0127 (TDD/TTY call 711). This and other publications are available at www.doh.wa.gov/drinkingwater.

No-Cost Workshop

WATER UTILITY MANAGEMENT: THE POWER OF PARTNERSHIPS AND EXAMINING YOUR FINANCIAL HEALTH

On September 26, 2018, Heather Himmelberger, director of the Southwest Environmental Finance Center, will teach you how to select the type of partnership that might best fit your needs and assess your financial health. The free workshop will run from 9 a.m. to 4:30 p.m. in Rooms 152 and 153 of the Point Plaza East building in Tumwater. The center requested continuing education units from Washington Certification Services.

Running a small system can be challenging. Along with meeting regulatory obligations and satisfying customer expectations, you may have decaying infrastructure, lack of personnel, and limited financial resources. Furthermore, small systems often cost more to operate on a per capita basis than large systems because of the economy of scale.

The first part of the workshop will focus on collaboration with other utilities. This may involve loose, informal networking or more structured arrangements, such as: operator networking meetings, sharing personnel, leveraging shared purchasing power, helping maintain regulatory compliance, or forming a regional water entity.

The second part of the workshop will focus on ways to assess your financial health, estimate the value of your utility to help put rates into context, and data-driven decision-making as a means to reduce costs.

If you have questions about the workshop, contact Francine Stefan at **mfstefan@unm.edu**. To register, visit the Innovative Finance Solutions for Environmental Services online at **efcnetwork.org**.

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